Winter 2005

CEG 433/633-01: Operating Systems

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Catalog Description: The management of resources in multi-user computer systems. Emphasis is on problems of file-system design, process scheduling, memory allocation, protection, and tools needed for solutions. Course projects use the C/C++ language and include the design of portions of an operating system. 4 credit hours.

Prerequisites: CEG 320, and CS 400.

Source Material

SG

Silberschatz & Galvin, Operating Systems, 6th Edition with Windows XP, 2003: John Wiley & Sons, Inc. Some previous editions are by Addison-Wesley.

RS

W. Richard Stevens, Advanced Programming in the Unix Environment, Addison-Wesley, ISBN: 0-201-56317-7.

Home Page

www.cs.wright.edu/people/faculty/pmateti/Courses/433/

News Group

wright.ceg.433 Post all your questions, helpful comments, criticisms, and suggestions regarding this course (lectures, projects, home work, exams) to our news group. I am hoping for a lively discussion leading to good answers and clarifications. Keep an eye on this newsgroup.

1. Course Content

The numbers in parentheses are a rough estimate of the number of (75-minute) lectures on each topic.

Project work is a significant part of this course. The ordering of lectures, in contrast to the course content topics listed below, is largely due to this influence.

Systems Software (4)

Components of a Computer System: Hardware, Systems Software and Applications.

Systems Software: Operating Systems, Monitors, bootstrap and regular loaders. Compilers, assemblers, macro-processors, and linkers.

Operating Systems: Interrupt handlers, device drivers, file systems, networking, memory management, multi-tasking, and resource control.

Hardware Characteristics Relevant to Operating Systems: Instruction set. IO hardware. Interrupts. Kernel and User modes.

The sequence of events from initial power-on cold booting to shut down of a computer system. The `ps` and related commands. The standard Unix processes: `init`, `getty`, etc.

Chapters 1, 2, and 3 of SG. Chapter 2 of RS.

Programming Support (4)

Project work is heavily dependent on the material of this section. Lectures are spread over the 10 weeks.

Using Unix: Man pages. Makefiles. Debugging. Executable binaries v. `bash` shell programming. IO redirection. Filters and pipes. Signal handling. Exception handling via `setjmp` and `longjmp`.

Systems implementation languages v. problem oriented languages, and command/script languages.

C and C++ Languages: Expressions and statements. Assignment statement as an expression. Block structure. Type compatibility. Pointers: `void *`, `T *`, pointers to functions. Prototypes. The Preprocessor directives. Portability.

Libraries: Standard libraries v. operating system calls. Unix system calls, and the standard. Shared libraries. Routines v. packages. Memory allocation, file io.

Chapters 1 - 4, 7, 10 of RS.

Memory Management (3)

Dynamic storage allocation and liberation. The `malloc+free`, `new+delete` of C/C++ languages, and the `sbrk` of Unix. Garbage collection.

Virtual memory. Address spaces. Swapping. Secondary storage. Page faults, Memory management units, and other architectural support for paging, and segmentation. Demand paging. Page replacement algorithms.

Chapters 8 and 9 of SG. Chapter 7 of RS.

File Systems (4)

The semantics of file `open`, `read/write`, `close` and `unlink`. Naming and allocation of resources. Hierarchical directories. Security and protection mechanisms. Keyboard, display, and mouse viewed as files.

Unix file system. The structure of i-nodes. Buffer cache. The mechanism of mount.

Chapters 10, 11, and 21 of SG; Chapters 3 and 4 of RS.

Device Drivers (2)

IO subsystem and Device Drivers: DMA; Interrupt handlers; driver interfaces; overview of drivers for: disk, clock, terminal. Disk scheduling, and management. Using disks and slow RAM for swap space. Chapters 12 and 13 of SG.

Case Studies (2)

Unix and Windows NT/2000. Discussion of Unix is spread across the entire course.

Chapters 21, 22, 23 of SG. Chapter 2 of RS.

Grading

Exams

There will be two exams contributing 30% and 35% to the final grade. The mid term is scheduled around the fifth week, and the final during the exam week as set by the Registrar.

Projects

The projects contribute 30% to the final grade. I expect to give the project in five parts worth 5+5+10+5+5% respectively. The due dates for these will be announced in class.

The projects will be evaluated based on three criteria: (1) approach, clarity, and elegance, (2) correctness, and (3) efficiency. These projects must be work done *solely by you*, except for the parts I provided you with. The implementation must be in `C or C++` demonstrable on our Linux systems. Projects must be submitted on-line using the `turnin` program.

I may ask you for a demo of your projects. During or after the demo, I may also ask you questions pertaining to your projects.

Homework Assignments

I will recommend that you work on various problems from the book and other places. However, as this course has currently no TA support, I will neither grade the solutions nor provide solutions.

Newsgroup Activity

`wright.ceg.433` Post all your questions, helpful comments, criticisms, and suggestions regarding this course (lectures, projects, home work, exams) to our news group. I am hoping for a lively discussion leading to good answers and clarifications. Keep an eye on this newsgroup. To encourage good

participation, I am assigning 5% of the total weight. I am not looking for mere volume of submitted articles, or just questions, but quality of answers and discussion you provide in the group.

CEG 633

Students enrolled in CEG 633 are required to do an additional reading on operating systems and write a brief report. This quarter the task is to search the Web and write a *technical* summary in a few pages on the *similarities/differences of the NTFS 5 file system used in Windows XP with the i-nodes based design of our project.*